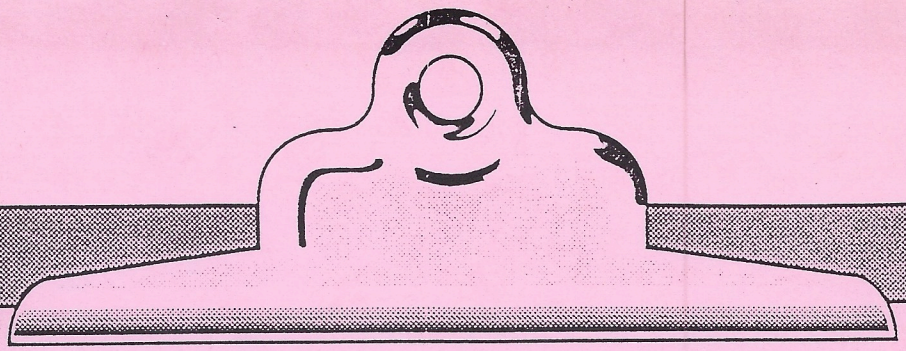


AGENDA FOR
BASIC SWITCH MAKING WORKSHOP

9:00 Introduction

9:15 Theory of the Atom: Tools, Equipment and Techniques
(or, Why do they work, what are we going to do, and, how are we going to do it?)

10:15 BREAK

10:30 Toy Adapter

11:45 LUNCH

1:15 Notebook Switch

2:15 BREAK

2:30 Mercury Switch

3:30 Wrap-up/Clean up

NOTES

The Basics of Switch Making

What is a switch?

Switch\ swich\ n.

1: a device for making, breaking, or changing the connections in an electrical circuit.

2: a device to turn off or on. (Webster's Dictionary)

An adapted switch enhances the ability of an individual with a disability to interact with the environment through an alternative access method, producing the desired result from a device. A switch is a way to create cause and effect with a device through an alternative method. The ability to operate a simple device can provide a variety of new opportunities for learning, growth and productive activities. Switches provide a variety of access and input methods to all types of assistive technology aids and devices for persons with disabilities. The alternative access of choice, or switch, will depend upon the functional capabilities of the user. Switch selection is based on the individual's most consistent, reliable body movement, and, the sensitivity and pressure required to engage the switch. Careful selection and placement of the appropriate switch and assistive technology device must be fully considered for the particular needs of the individual user. To maximize potential benefits of switches and assistive technology aids and devices for the individual user, proper seating and positioning, use of functional motivating equipment and direct, systematic instruction are important factors for success.

Children and Switches

- The keys to using a switch are: 1. Creativity;
  2. Thinking like a child who is disabled.

- Switches can be ***adapted, created, formed, or changed into any size, shape, color, sensitivity, or texture*** that is appropriate for an individual child.

- Any child, regardless of their handicapping condition can control a switch if it is appropriate and positioned properly.

Educational Applications for Switches

1. Active stimulation
2. Active interaction
3. Increase motor control
4. Increase academic levels
5. Environmental control
6. Signaling device
7. Language (communication) access
8. Computer access
9. Independence (daily living activities)

Common Toy and Switch Terminology

Cause/effect -

Activating the toy through levers or switches causes an immediate change in the toy (ie., pieces fall, the toy operates or stops operating).

Complex operation -

Toy requires sequencing of buttons or following directions with multiple steps.

Insertion of pieces -

Toy requires that pieces be placed into slots or holes before activating.

Interactive -

The toy has features that foster play with another child or adult.

Mobile -

Moves around when activated.

Simple operation -

Toy is easy to operate and does not require sequencing of buttons of following directions with multiple steps.

Stationary -

Does no move when activated; remains in one place during activation.

Switch activated toy -

Any toy that uses some mechanism to activate. This could include levers, handles or buttons that are pushed.

Tactile -

Toy vibrates or has features which do not require vision or hearing for interaction.

Notes

Tips and Tricks:
Adapted Toys and Switches

REMEMBER:

1. The person must be correctly positioned. Success with the equipment depends on this! Occupational and/or physical therapists should be involved in the decisions of positioning and the types of switches to use. The therapist will try to minimize primitive reflex patterns and work toward more positive motor skill development.

2. Switches and toys should be used with a purpose, especially with severely and profoundly involved children.

3. Understand that you may need to wait for a response. Many times, these devices will work after a period of time with a child, as the child needs an adjustment and reaction period.

4. Change reinforcers periodically. Adults as well as children outgrow interest in certain toys after a period of time.

5. Always consider the mood of the individual, the individual's health, the presence of environmental distractions (other people, TV, radio, traffic noise, etc.) time of day, and your mood!

6. Purchase battery operated devices with an on/off switch that use AA, C and D size batteries.

7. Look for novel items that can be used by adults and older children, such as closet lights, radios, small fans, etc.

8. Check to see that the battery compartment and switch are attached to a non-moveable part of the device.

9. Used toys and devices can be purchased at garage sales and flea markets. Test the item before you buy it to be sure that it works properly.

Notes

Suggested Switch Making Supplies and Materials

Tools

Hand-held drill and drill bits (ranging from 1/8" to 1/4")

Screwdrivers - assorted sizes, both Phillips and flat

Wire cutters

Needle nose pliers

Tin snips (or old scissors) to make copper wafers

Soldering iron (25 watts)

Wire strippers

Helping hand (holds pieces that need soldering to prevent burns)

Battery tester

Continuity tester to test completed circuit

Various files

Coping or hack saws

Materials

22 or 24 gauge double stranded speaker wire

Masking tape (or electrical tape)

Rosin core solder

Sub-miniature jacks and plugs (1/8" and 1/4")

Wet sponges to clean soldering irons

Copper foiling to make copper wafers

Notes

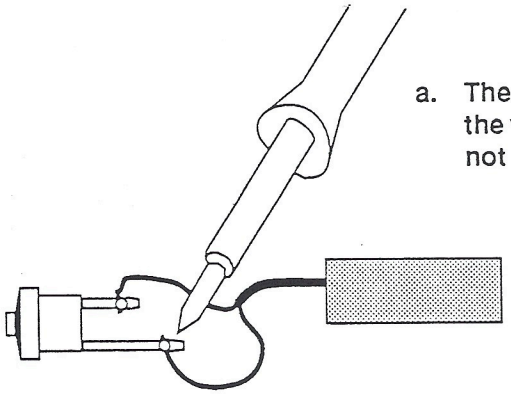
Soldering Tips

Soldering is not difficult. For best results, use an iron with a small tip and use thin rosin core solder. Only a small amount of solder is needed for an electrical connection.

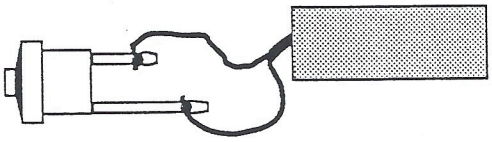
How to Solder a Wire to a Terminal

1. Make sure that both the wires and plug or jack terminals are clean. If they are not, clean with a small piece of steel wool. Cut off the end of the wire and strip off another 1/2" of the plastic coating.
2. Thread the stripped wire through the hole in the terminal and twist it back to itself.
3. Heat both the wire and the terminal with the soldering iron. Touch the rosin core solder to the connection and it should melt onto the wire and the metal if you have heated them enough. Hold the connection still until the solder cools and hardens.

   You may want to hold the parts with pliers or tape them to a board instead of holding them in place with your fingers. This may be necessary because the wire and other parts can get very hot. Do not cover the actual connection with tape.
4. Check the connection between the wire and the metal by using the wiggle test.



a. **The wire will wiggle in the hole if either the wire or the metal is moved. This is not a good connection.**



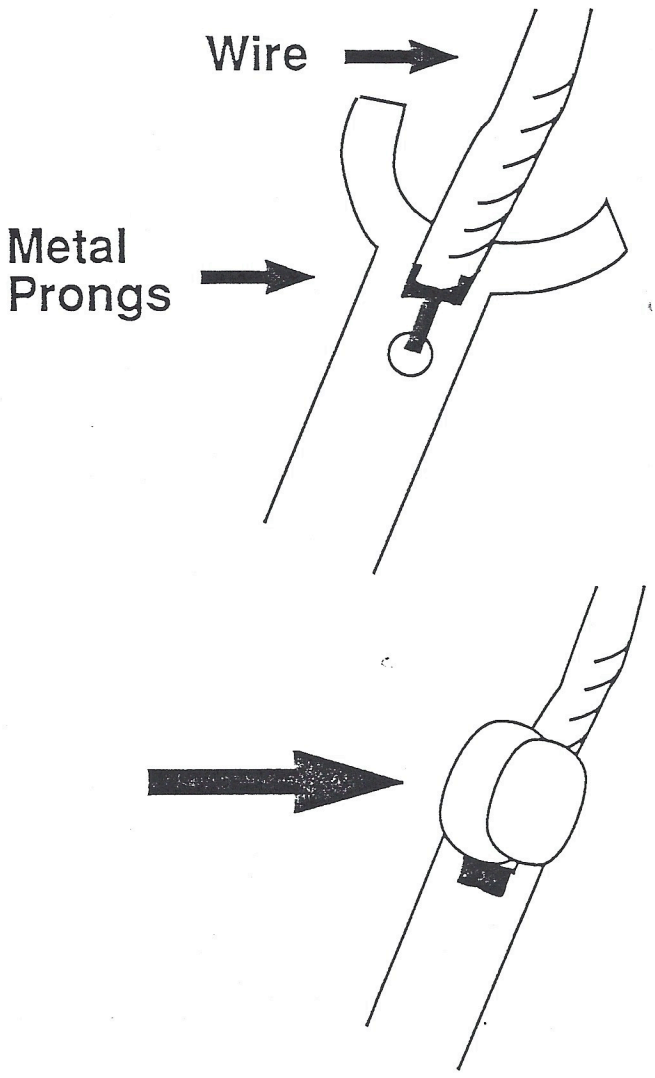
b. **The solder should cover both the metal and the wire. When you wiggle either piece it should move as one piece.**

Notes

Alternatives to Soldering

Radio Shack and other electronic stores sell small strips of soldering tape which are wrapped around the connecter and wire and then heated with a match or a candle. These are awkward to use for fine work of sub-miniature size parts.

There are also "solderless" connectors used to connect wires. These are available from Radio Shack or other electronics stores. The end is pinched around the exposed wire with pliers to form a connection. The exposed terminal end is then inserted into the wire end connector to finish the wiring process.



Notes

Assessment Guide for Determing Switch Control

Name _____ Date _____

QUESTIONS	BODY PART							
	HAND	ARM	LEG	FEET	HEAD	CHIN	FACE	OTHER
Specific body part activating switch								
Type of switch								
Location of switch								
Movement used to activate switch								
Turns switch on?								
Turns switch off?								
Turns switch on upon request (how many times of 5?)								
Turns switch off upon request (how many times of 5?)								
Can activate it without looking at the switch								
Can activate it accurately, for a specific # of times and stop? (Manual Scan)								
Accurately turns switch on when presented with a prompt? (Automatic Scan)								
Can hold switch on for long and short time (Morse Code)								
Does child like the movement?								
Does child like the switch?								
Is there minimal tiring/fatigue?								
Switch will not interfere with function?								
Are the same results obtained at a later date?								

Troubleshooting Your Switches

Common Problem	Cause	Solution
The toy does not operate. The toy does not work from the original switch.	A. Batteries need replacing B. Wiring is shorted or broken C. Original switch is faulty D. Internal toy problem: broken motor, linkage, etc.	A. Replace batteries B. Open the toy and trace the wiring, resolder if necessary. Cover exposed wires and/or connecting wires. C. Rebuild or replace the switch (if possible) D. Replace parts if possible
The toy works with the original switch but not with the adapted switch.	A. Faulty adapted switch B. Wiring break in the adapted switch or adapted wiring at any point C. Copper wafer is displaced and not making complete contact with the battery post.	A. Rebuild or replace switch B. Trace wiring in the toy or copper wafer, resolder if necessary. C. Reposition copper wafer onto post to make a better contact.
The toy runs continuously. **The toy runs continuously without the adapted switch being plugged in after the adapting techniques have been completed.**	A. The toy switch is in the ON position B. There is a wiring short in the adapted wiring C. There is a wiring short in the toy wiring	A. Turn the switch OFF B. Trace wiring, cover exposed wires and connecting wires. C. You may need to open the toy to do this. The toy runs continuously with the adapted switch plugged in.
	A. A short is in the external jack leading to the adapted switch B. There is a wiring short in the adapted switch C. There is a wiring short in the adapted wiring	A. Open the cap on the jack and resolder the wires B. Rebuild or replace the switch C. Trace the wiring, cover the exposed wires and connecting wires. You may need to open the toy to do this.
There is intermittent toy operation when moving the wires or the toy.	A. The batteries are low and need replacing B. There is loose or faulty wires in the jack or adapted wiring C. There is loose or faulty wires in the toy. D. There are internal toy problems: broken motor, linkage, etc.	A. Replace the batteries B. Trace the wiring, cover the exposed wires and connecting wires. You may need to open the toy to do this. C. Open the toy and trace the wiring, resolder if necessary, cover exposed wires and connecting wires D. Replace parts if possible
Toy operates slowly.	A. The batteries are low B. Internal toy problems: broken motor, linkage, etc.	A. Replace the batteries B. Replace the damaged or broken parts if possible

References

Enclosed materials have been adapted from the following sources:

Baumgart, D., Brown, L., Pumpian, II, Nisbet, J., Ford, A., Sweet, M., Messina, R., and Shroeder, J. (1982). **Principle of partial participation and individualized adaptations in educational programs for severely handicapped students.** The Journal of the Association for the Severely Handicapped, 7, 17- 27.

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Stokes, T. F., and Baer, D. M. (1977). **An implicit technology of generalization.** Journal of Applied Behavior Analysis, 10, 349- 367.

SWITCHING ON: The Basics of Switch Making. An interactive workshop co-sponsored by Carolina Computer Access Center, Charlotte, NC, and the Center for Rehabilitation Technology Services, Columbia, SC, September 27, 1990 in Charlotte, NC.

Williams, W. and Fox, T. (1980). Minimum Objectives System for Pupils with Severe Handicaps. (4 volumes). Monograph Series. Burlington, VT: Center for Developmental Disabilities.

The Center for Rehabilitation Technology Services assumes no responsibility or liability for damage or injury directly or indirectly caused by the use or misuse of the switches and devices constructed from the instructions described in this package or from any other causes.

Battery Toy Adapters

Battery toy adapters allow ability switches to be used with battery operated toys and lights. The toy adapter has a subminiature size jack at one end and a brass or copper disk at the other end. The disk slips between the battery and the metal terminal of the toy. The toy adapter can be removed easily so the toy can be used by others not requir ing a switch. Once constructed, the toy adapter can be used in any other toy using the same size batteries. Use the copper wafer method when toys are sealed and cannot be opened by removing screws to access the battery holder.

Required parts and materials:

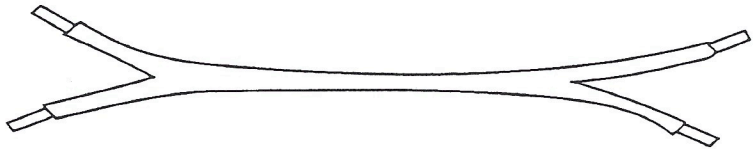
1 thin sheet of brass or copper tooling foil
1 plastic food container lid, side of a plastic milk carton, or a piece of cardboard
1 double-sided carpet tape
1' 22 or 24 gauge double stranded wire (two conductor) speaker wire)
1 1/8" sub-miniature size jack (female)

Required tools and equipment:

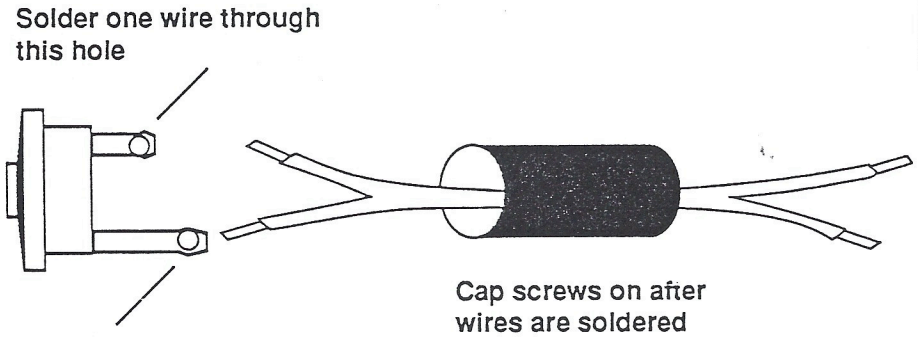
needle nose pliers
rosin core solder (60/40, .010)
soldering iron (25-30 watts)
de-soldering wick braid
masking tape or electrical tape
wire strippers/clippers
wet sponge
scissors

Toy adapter construction:

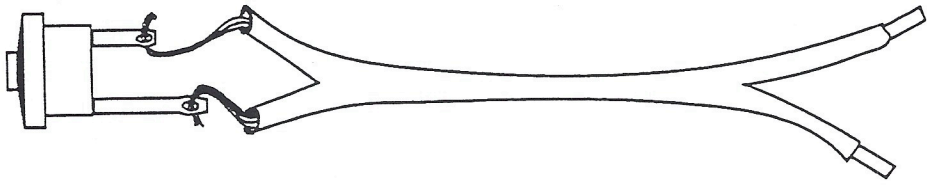
1. Separate both ends of the double stranded wire by splitting apart about 1 1/2". Strip about 1/4" of the plastic insulation coating off each end of the each split wire. Carefully twist the exposed wire to join the thin strands smoothly together.



2. Unscrew and remove the jack from the plastic housing cap. Thread the end of the wire through the plastic housing cap so the threads are turned away from the exposed ends of the wire.



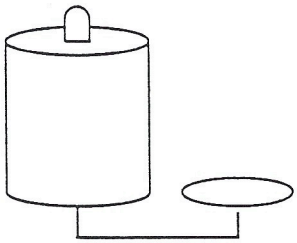
3. Insert the stripped wire ends into the holes in the terminals on the jack. Solder the wire ends to the jack terminals. Screw the cap housing back onto the jack.



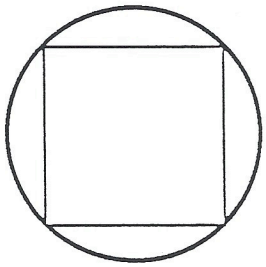
Notes

4. Identify the battery size used in the toy. Trace around the end of the correct battery size used in the toy on the plastic lid, milk carton or cardboard and cut out the circle.

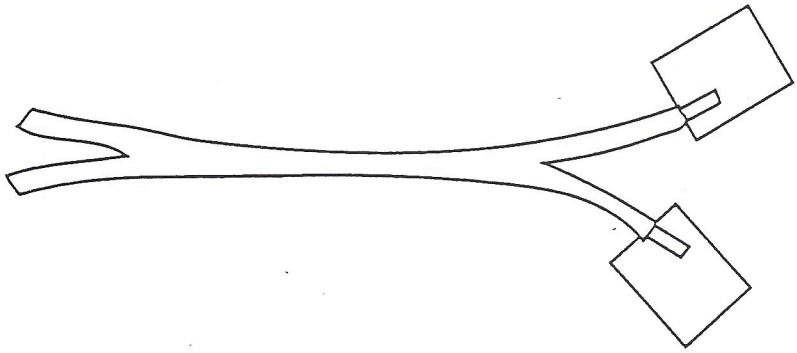
   (Look at the contact point of the battery. This is where the wafer will be placed. In some cases, a groove may be seen. Cut the wafer to fit that area. Otherwise, a good contact point will not be made and the interrupt will not function properly.)



5. Cut two squares of brass or copper just slightly smaller than the plastic circle.



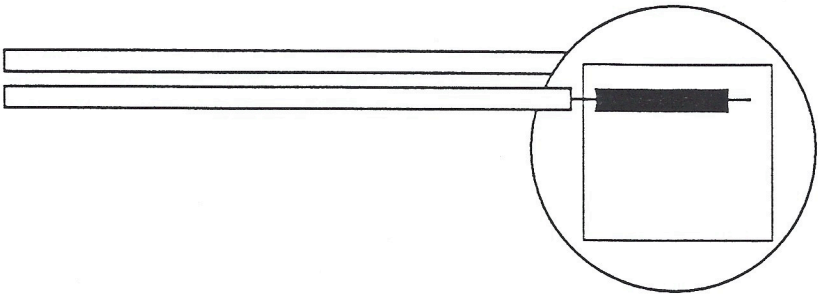
6. Solder the ends of the wire to the edge of each piece of brass.



Notes

7. Place a piece of carpet tape on the back of each piece of metal and trim it to the same size as the metal end.

8. Remove the paper from the other side of the tape. Press this against one side of the plastic circle. Remove the carpet tape paper from the other metal piece and attach it to the opposite side of the plastic.



9. The toy adapter is now ready to use. Slide the disk between the battery and the metal piece of the battery compartment. This will interrupt the circuit.

   The wire with the jack on the end will now be extending outside the toy. Examine the battery compartment lid closure and be sure there is enough room for the toy adapterwire to slip through. If the space is not large enough, use a knife or file to notch a corner off the battery compartment lid. This allows the wire to pass outside the toy with the battery compartment lid closed.

   Turn the switch of the toy to the "on" position. The toy should remain inactive. Plug the ability switch into the jack and activate the toy by pressing the switch.

Notes

Notebook Pressure Switch

The notebook pressure switch is a flat pressure sensitive switch. It can be made to any size depending upon the need of the activity and the ability of the person using the switch. Touching almost any part of the switch surface will activate the switch. When the pressure is released, the switch is turned off. The switch can be placed in many positions and activated by many body parts.

This switch can be used to control a tape recorder or a battery powered toy or light. For instance, it can also be used in conjunction with the computer through a joystick port or with the Adaptive Firmware Card (AFC) to send commands to the computer for communication, cognitive training and environmental control. Because the switch is so flat, it can be placed under pictures or textured cards to encourage communication training.

Used on a table top, this switch can improve cause and effect learning and association skills and basic discrimination skills. A small notebook switch placed under a laptray teaches signaling and discrimination learning. Touching the desired object or picture will cause the activation of a buzzer, light or an occurrence on the computer equipped with an AFC device. Ultimately, this simple pressure switch could become a substitute for the keyboard.

Placing the switch under a rug with the person laying on it, can prompt continued prone positioning on that part of the rug. If the person rolls over off the switch area, the music or reward is turned off. Weight bearing in any position can be influenced using a similar methods.

Notebook Pressure Switch

Required parts and materials:

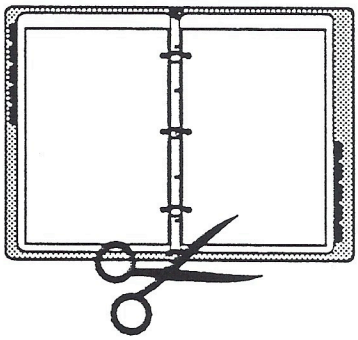
1 plastic notebook flexible binder (2 or 3 ring)
1 oven liner (or 2 large foil cookie sheets), disposable type
1 1/8" miniature size plug (male)
4' 22 or 24 gauge double stranded (two conductor) speake wire
1' double-sided FOAM tape (thin foam that is sticky on both sides)

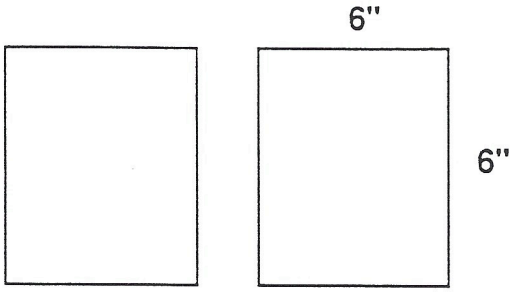
Required tools and equipment:

needle nose pliers
rosin core solder (60/40, .010)
soldering iron (25-30 watts)
de-soldering wick braid
masking tape (or book binding tape)
wire strippers/clippers
wet sponge
kitchen table spoon
scissors
awl, large nail or hole puncher to punch hole

Construction:

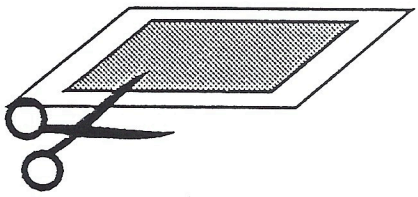
1. Using the scissors, cut the front and back covers off the notebook and discard the center binding. Cut the notebook covers into square pieces, 6" x 6".

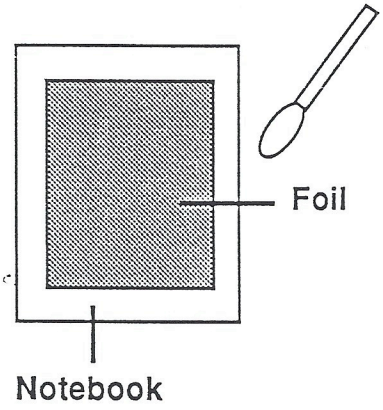




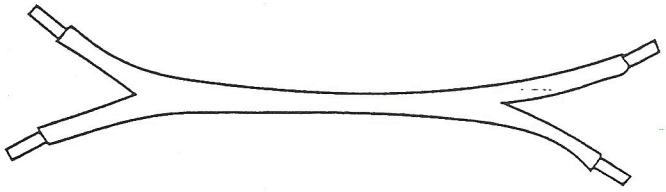
2. Cut around the sides of the oven liner (or the 2 foil cookie sheets). This will give you a flat sheet of metal foil. Trim the sheet about 1/8" inch smaller than the notebook covers (5 3/4" x 5 3/4"). Smooth out the wrinkles and ridges with the bowl of a kitchen table spoon.

   (CAUTION: Do not use your fingers, the metal may have sharp edges).



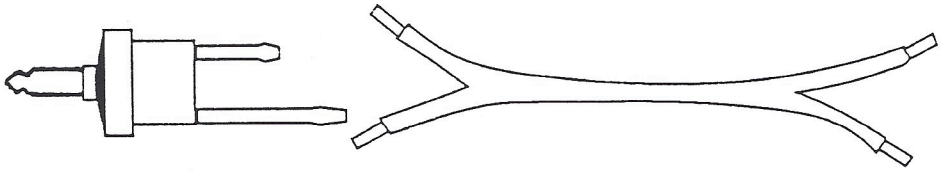


3. Separate both ends of the double stranded wire by splitting apart about 2". Strip about 1" of the plastic insulation coating off one end, and about 1/4' off the other split wire end. Carefully twist the exposed wire to join the thin strands smoothly together.

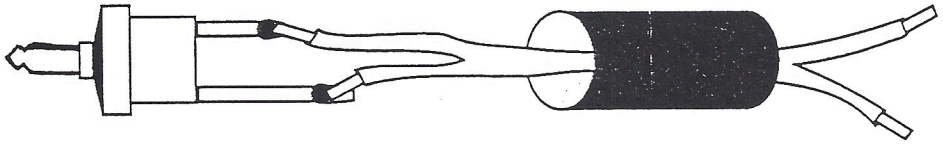


Notes

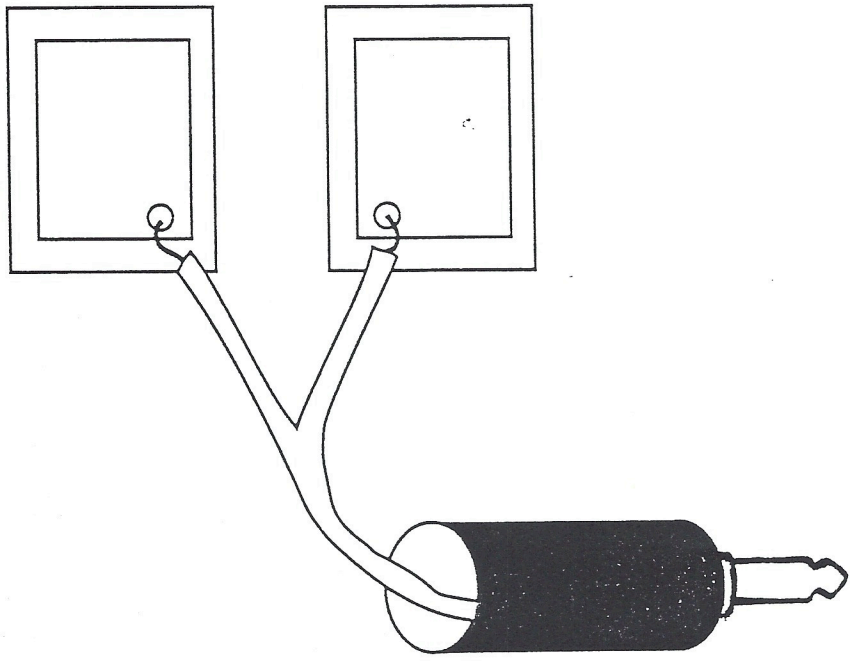
4. Unscrew and remove the plug from the plastic housing cap. Thread the end of the wire through the plastic housing cap so the threads are turned toward the exposed ends of the wire.



5. Insert the stripped wire ends into the holes in the terminals on the plug. Solder the wire ends to the plug terminals. Screw the plastic cap housing back onto the plug.

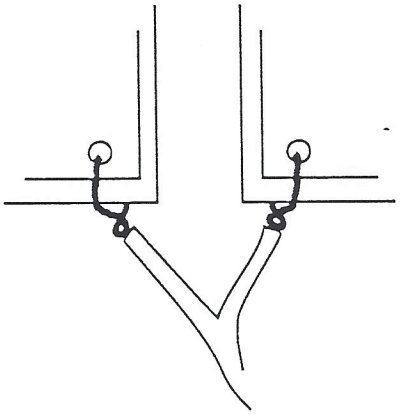


6. Use a sharp object to punch a hole about 1/4" from the corner of each sheet of metal. Use opposite edges of the two pieces, as they will be "sandwiched" together to form the inside of the switch.

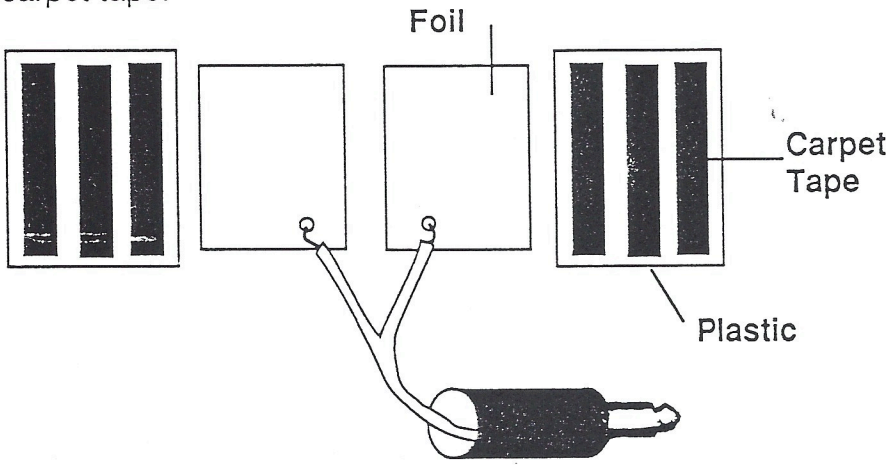


Notes

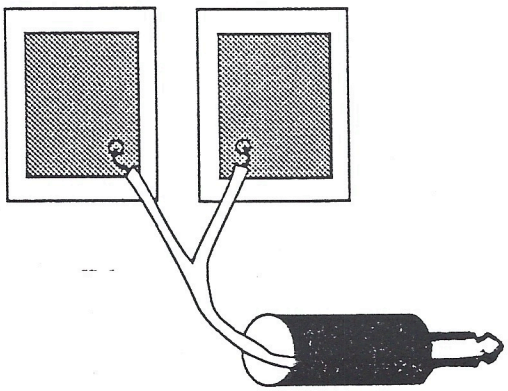
7. Thread one stripped wire end through the hole in the foil piece. Fold the wire back and twist it firmly to itself. (Do not try to solder the wire to the aluminum because the aluminum will react chemically with the solder flux and will not form a good connection.) Use a small piece of tape to cover the exposed twisted wire, and hold it firmly onto the aluminum. Rub your thumbnail over the tape to insure a good electrical connection between the wire and the foil sheet.



8. Tape one surface of each notebook cover together with strips of carpet tape.

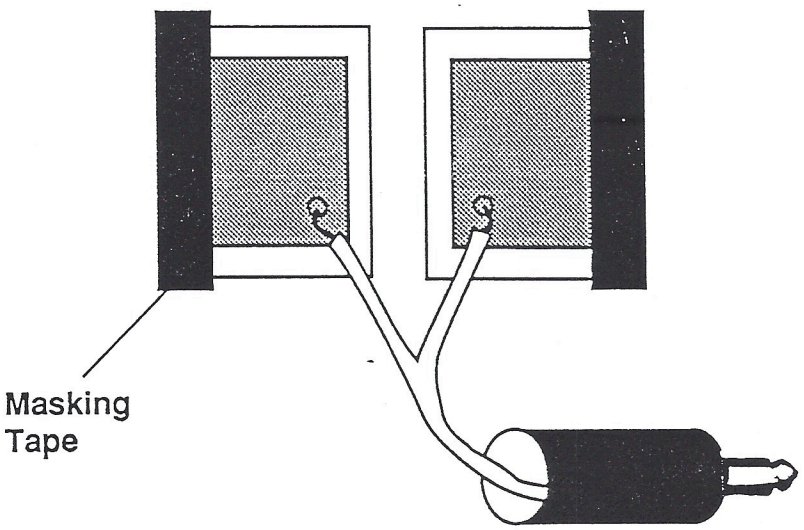


9. Remove the protective paper on the surface of the carpet tape and press one sheet of foil onto each cover (note: try to get the side which has the twisted wire surface to face the inside of the notebook cover).

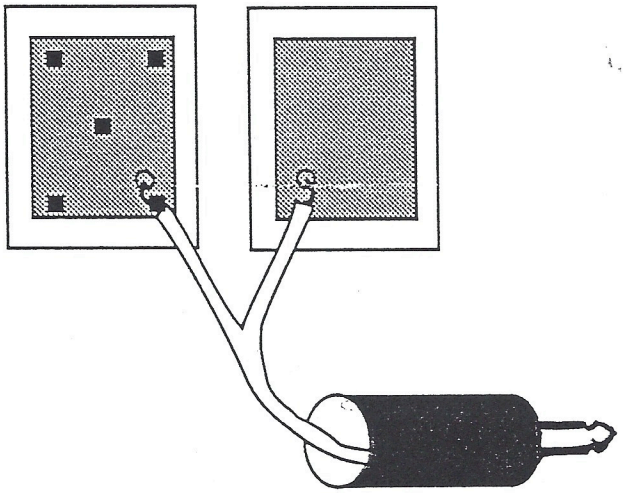


Notes

9. Use masking tape to cover all raw edges of the foil sheet by about 1/8" - 1/4" and fold extra tape around the back of the cover.



10. Cut 5 small strips of foam mounting tape. Place a piece in each corner and the center of one foil sheet. The size of the strips will depend on the size of the switch and the thickness of the foam.

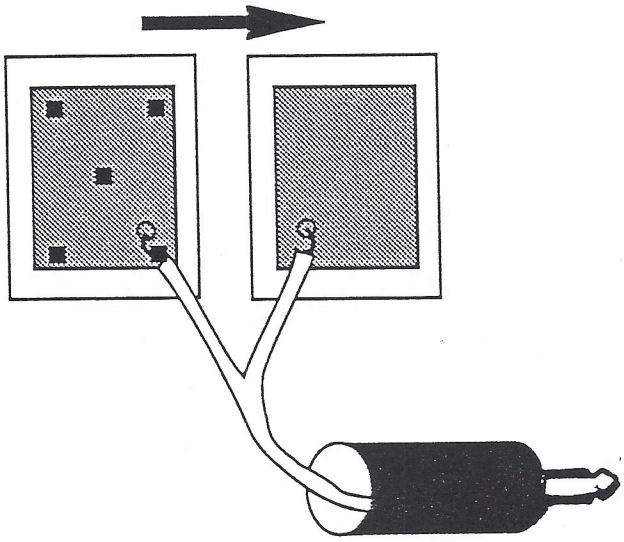


11. Place the two covers together with the foil sides facing each other. Experiment with the switch to test how easily it can be turned on and off. The sides should spring apart after pressure is released from the switch. If it is too difficult to press, use smaller pieces of mounting foam.

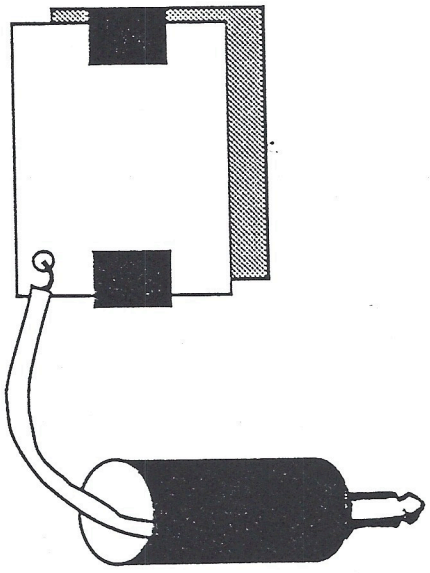
    A light touch will cause the two sides to meet. You can adjust this by using different sizes of foam tape andplacing tape in different areas between the foil surfaces. If the switch is to be used under a rug or other gravitypressure surface, you may need extra mounting foam or thicker foam insulation depending on the weight.

Notes

12. When you feel you have the right amount of foam between the notebook covers, remove the paper cover from the tape and press the notebook covers together. Use a small piece of tape to lightly secure the two ends. (If the tape is too tight, it may cause the switch to turn on.)



13. Test your switch to make sure it is not in constant contact. You may need to adjust the contact areas by bowing out the sides a little.



Notes

Mercury (TILT) Switch

The mercury switch, or tilt switch, turns a device on when it is held in an upright position, and turns the device off when the switch is tilted sideways or downward. Placing the switch on the head will encourage the person to hold their head up to activate a device as a motivational reward. Other body parts may be used to encourage desired movement or to reduce undesired movement. For individuals who have only voluntary head control, this switch gives the person control and interaction with devices in their environment.

Various stimuli can be adapted for use with the mercury switch. It is important to recognize what stimulus is motivating for the person, for example, a certain type of music, a toy, voice recorded on a tape, etc. Record this information on a cassette recorded. By inserting the mercury switch into the remote jack, and depressing the play button, the switch will act as an on/off switch depending on the position it is in. Determining the best angle will require a little experimentation.

Required parts and materials:

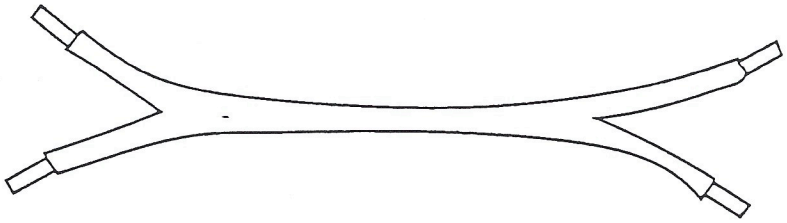
1 glass mercury switch
1 1 1/2" length of PVC pipe, inside diameter 1/2"
1' 22 or 24 gauge double stranded (two conductor) speaker wire
1 1/8" sub-miniature size plug (male)

Required tools and equipment:

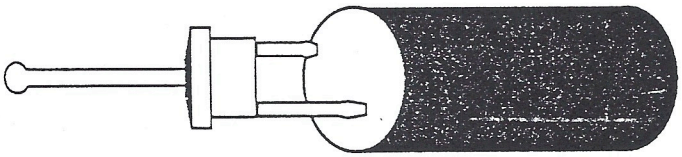
rosin core solder (60/40, .010)
soldering iron (25-30 watts)
de-soldering wick braid
wire strippers/clippers
wet sponge
tube of white silicon

Construction:

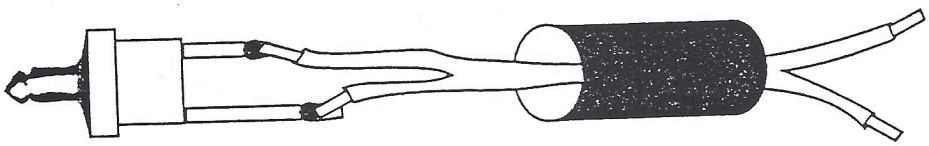
1. Separate both ends of the double stranded wire by splitting apart about 1 1/2". Strip about 1/4" of the plastic insulation coating off each end of the each split wire. Carefully twist the exposed wire to join the thin strands smoothly together.



2. Unscrew and remove the plug from the plastic housing cap. Thread the end of the wire through the plastic housing cap so the threads are turned toward the exposed ends of the wire.



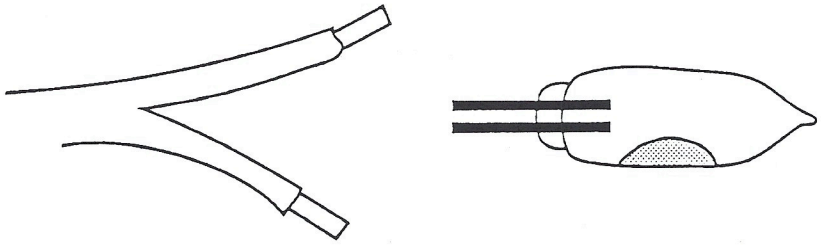
3. Insert the stripped wire ends into the holes in the terminals on the plug. Solder the wire ends to the plug terminals. Screw the cap housing back onto the plug.



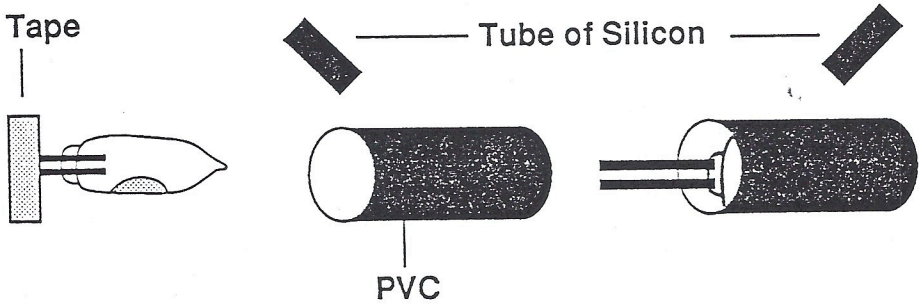
Notes

Mercury (TILT) Switch

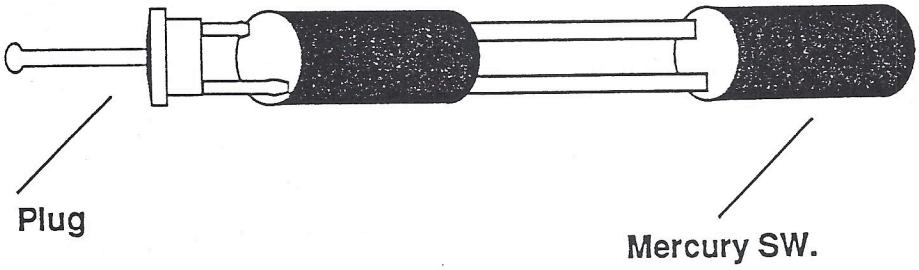
4. On the other end of the wire, solder one stripped end to each one of the terminal ends on the mercury bulb.



5. Place masking tape around the soldered terminals. Insert the mercury bulb into the PVC plastic tubing. Tape the exposed end of the PVC tubing. Using the silicon, fill the area around the bulb, forming a solid enclosure to prevent spillage of mercury, should the bulb become damaged. Remove the tape from the exposed end of the PVC, and fill this with silicon. Let this set up overnight.



6. After the switch has set overnight, remove the masking tape from the terminal end of the mercury bulb. You are now ready to use this as a switch interface.



Notes